

State of the Industry for Optical Ethernet

A large, artistic image of an optical Ethernet cable. The left side shows a dense bundle of fiber optic strands that fan out and glow with blue light. The right side shows a standard RJ45 Ethernet connector with a white plastic housing and a metal shield.

John Hawkins

MEF / Nortel Networks

NFOEC

Sept 7, 2003

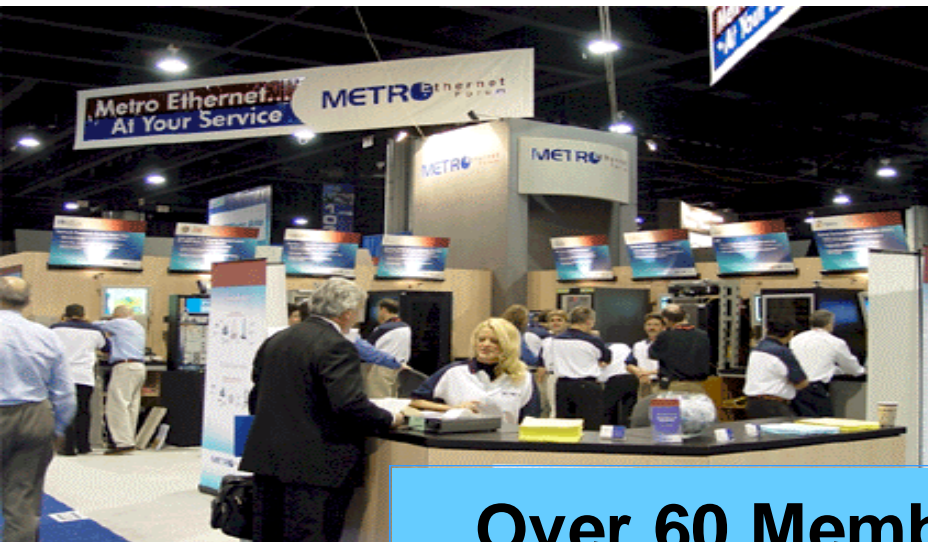
Agenda

- ✓ Intro to MEF & Optical Ethernet Services
- ✓ What's Happening with OE in the Enterprise
- ✓ Service Providers in OE Trial Mode
- ✓ Market Forecast & Opportunities
- ✓ Making Ethernet Carrier Class



Metro Ethernet Forum Mission

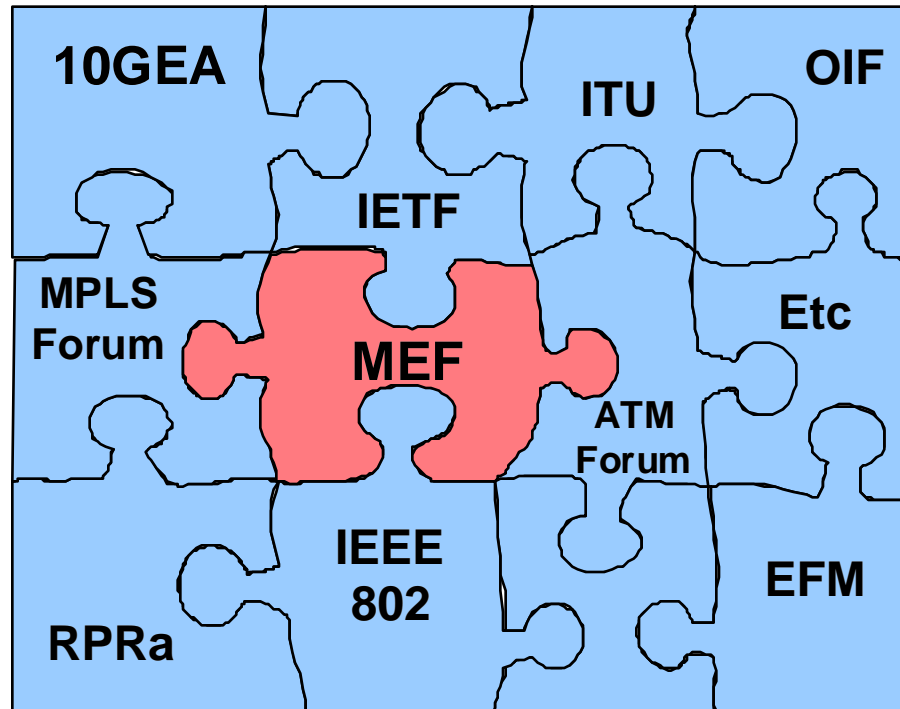
*Accelerate adoption of Optical Ethernet as
the technology of choice in metro
networks worldwide*



www.MetroEthernetForum.org

Over 60 Member Companies in just 2 Years

Approach to Technical Standards

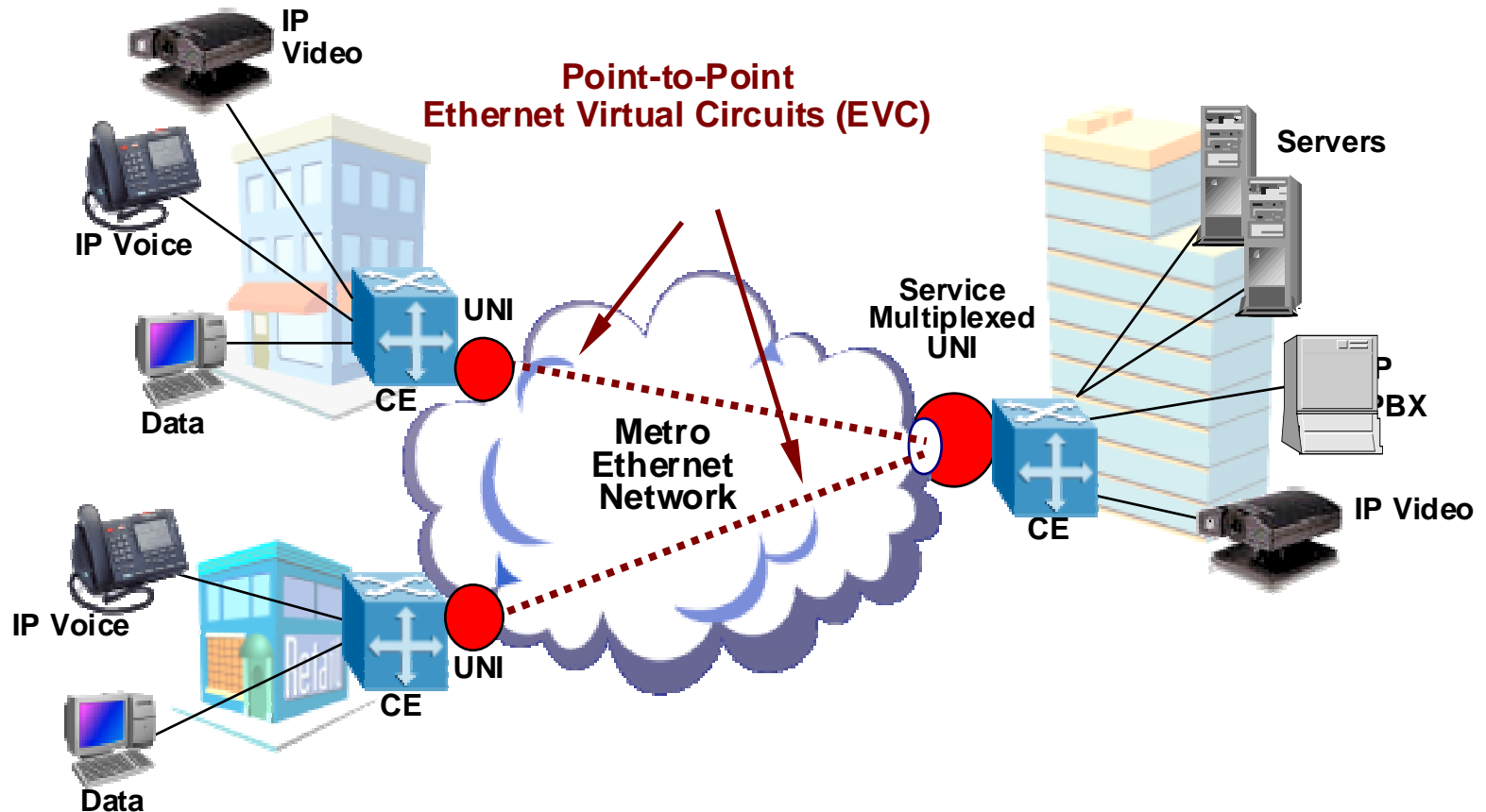


Optics



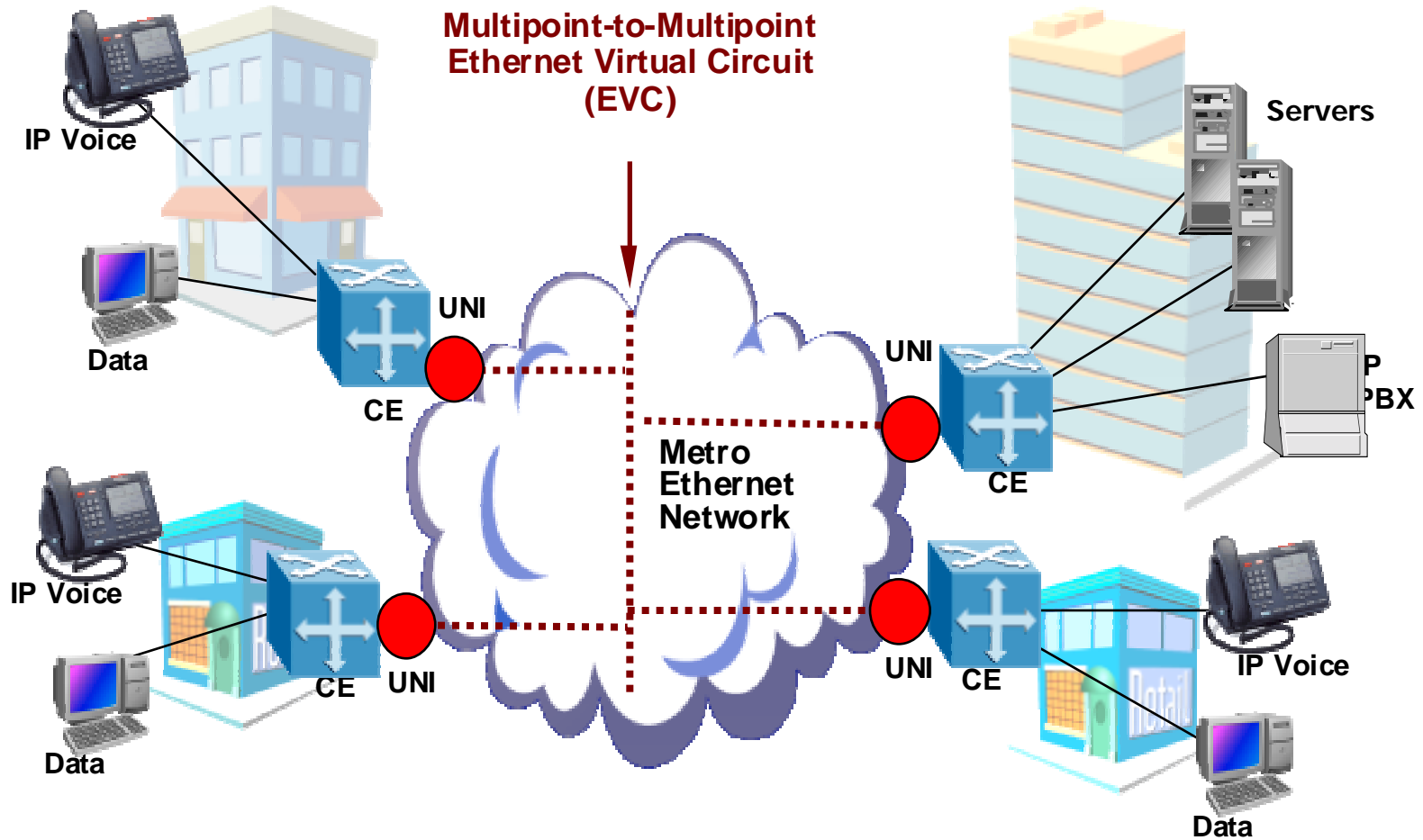
Use existing Standards and only fill the technical gaps for Optical Ethernet

Ethernet Line (E-Line) Service



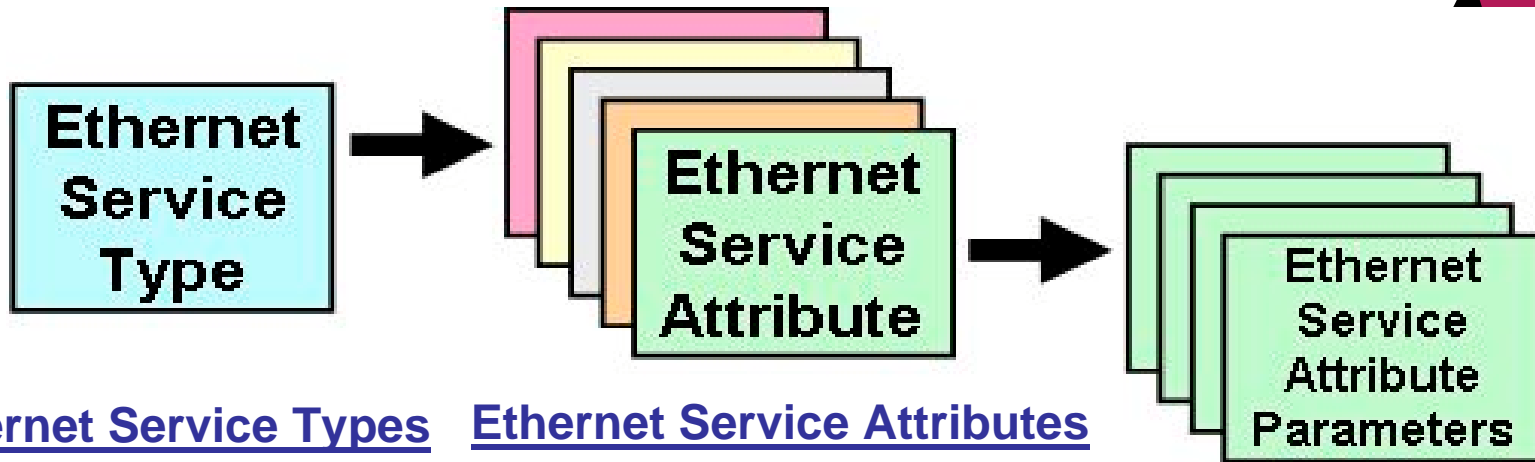
Point-to-Point Optical Ethernet Service

Ethernet LAN (E-LAN) Service



Multi-Point to Multi-Point Optical Ethernet Service

Ethernet Services Toolbox



Ethernet Service Types

Ethernet Line Services
(Point-to-Point)

Ethernet LAN Services
(Point-to-Multipoint)

Ethernet Service Attributes

Ethernet Physical Interface

Traffic Parameters

Performance Parameters

Class of Service (COS)

Service Frame Delivery

VLAN Tag Support

Service Multiplexing

Bundling

Security Filters

Traffic Parameters

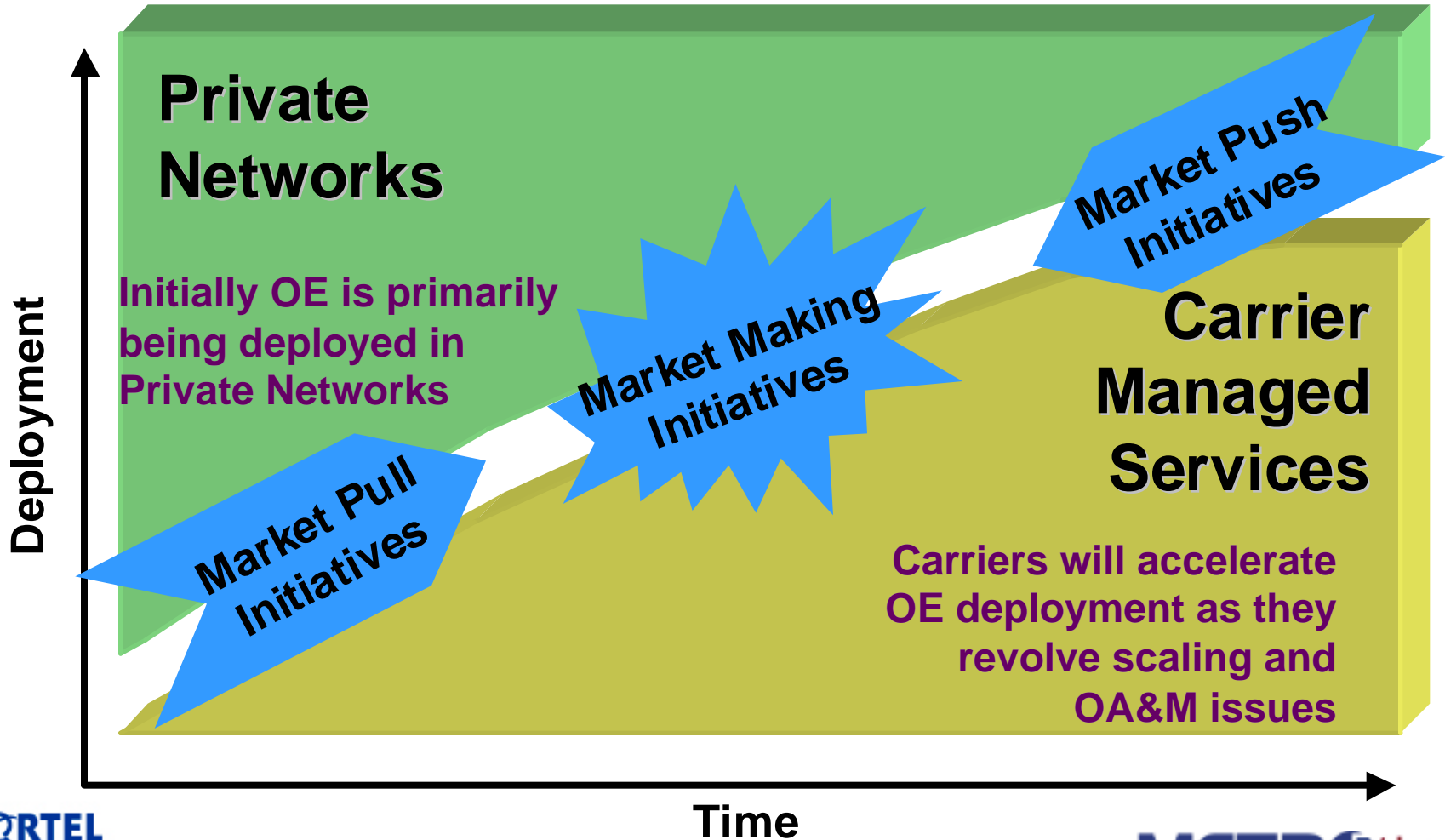
Committed Info Rate (CIR)

Peak Info Rate (PIR)

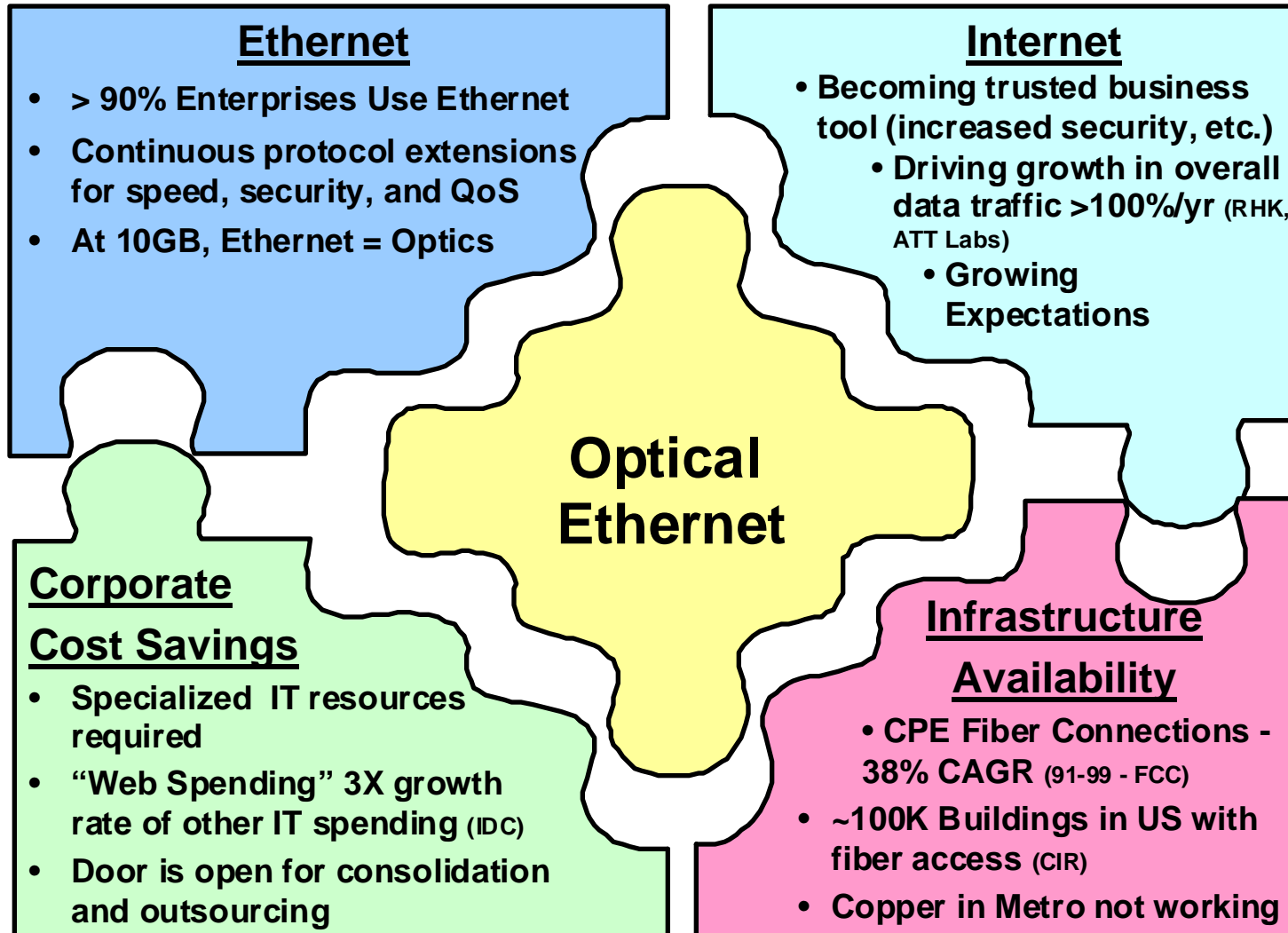
Committed Burst Rate (CBR)

Peak Burst Rate (PBR)

Optical Ethernet Go-to-Market *Push/Pull Strategy*



Why Now?

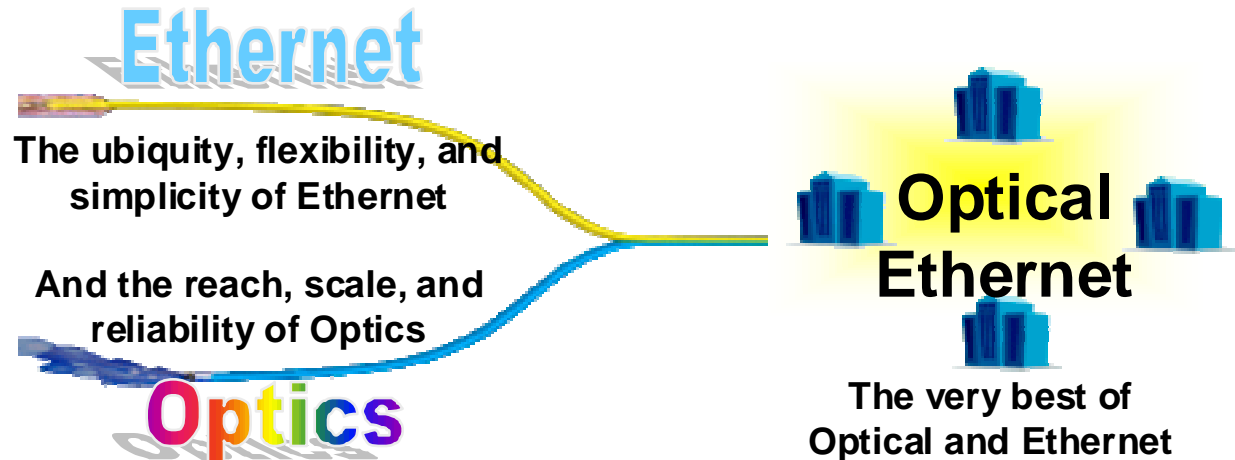


Combining Optical & Ethernet

What It Enables

A Complete Set of Profitable Connectivity
And Enabled Services & Applications

What It Combines



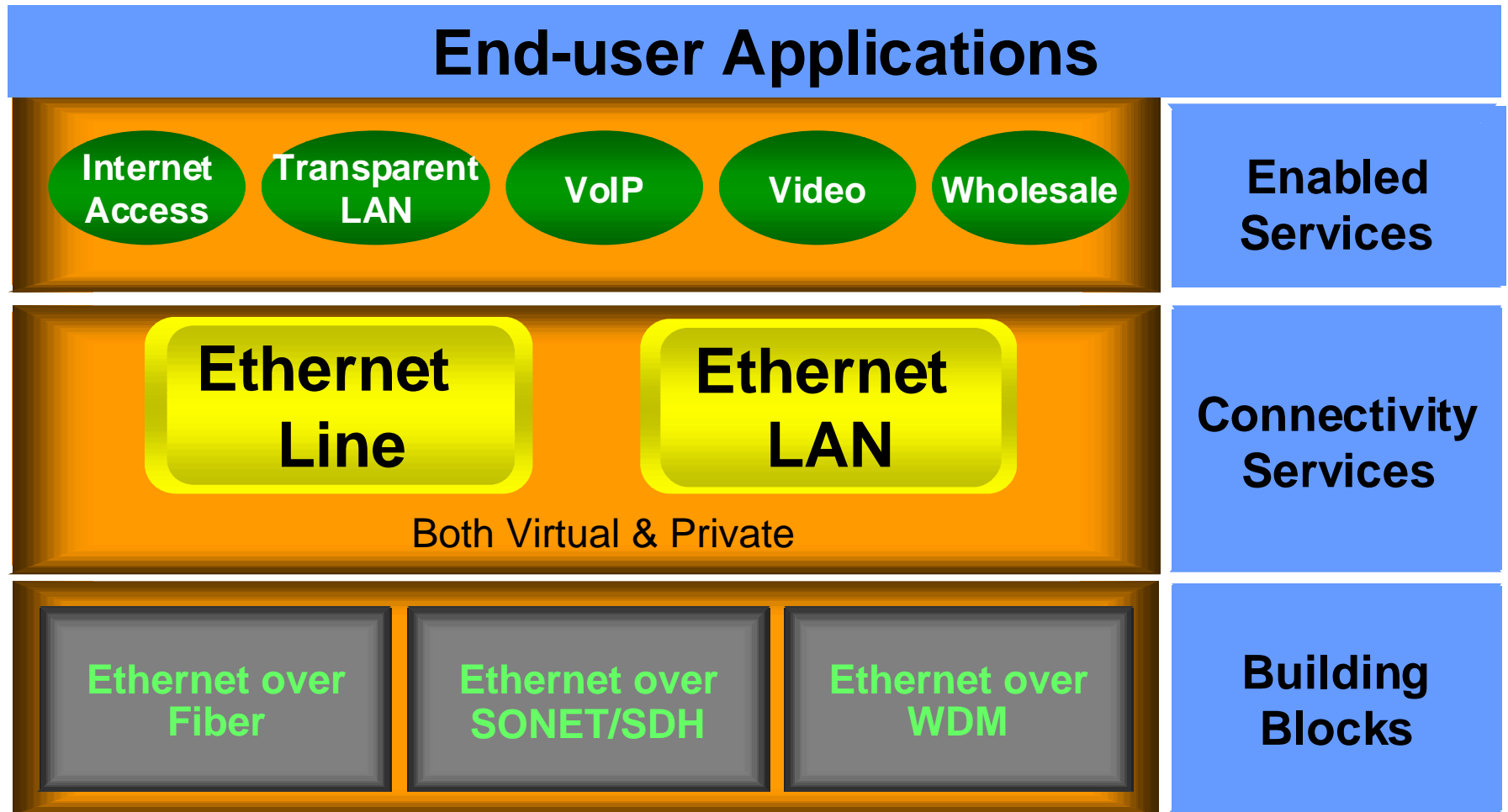
What It Builds Upon

Ethernet Over
WDM

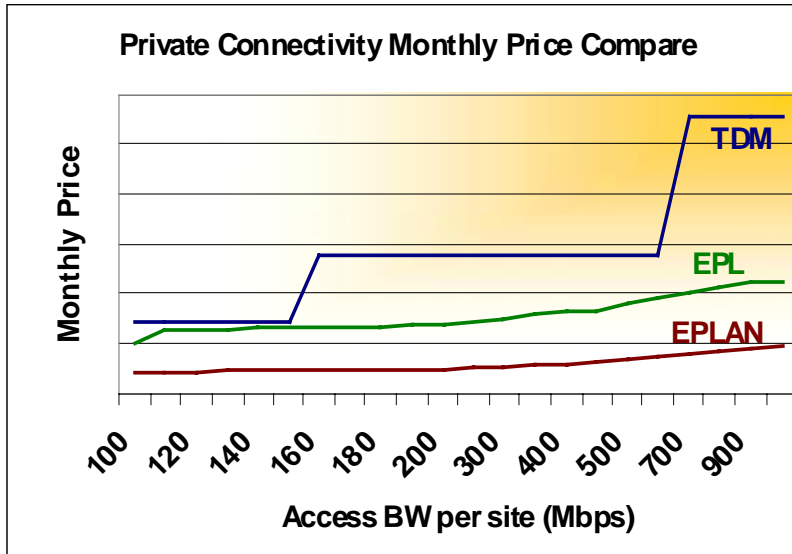
Ethernet Over
Next Gen
SONET/SDH

Ethernet
Over Fiber

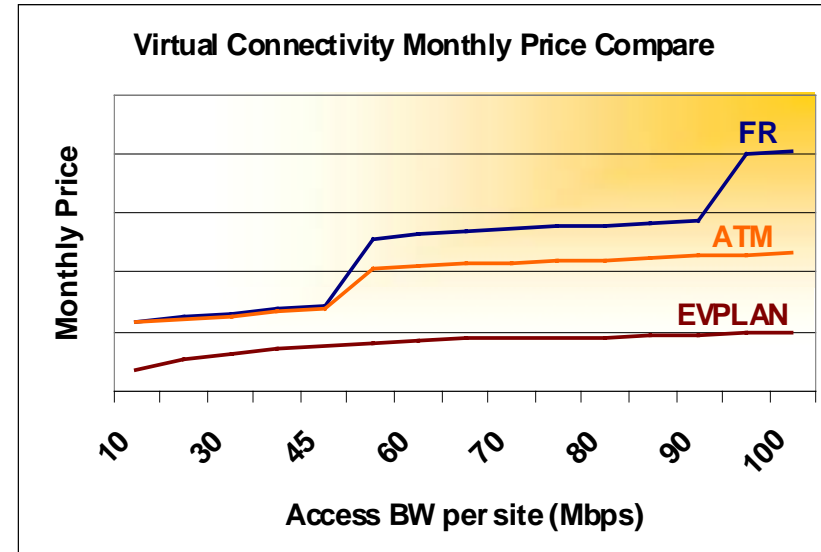
OE Services Framework



Alignment of Service Pricing Models



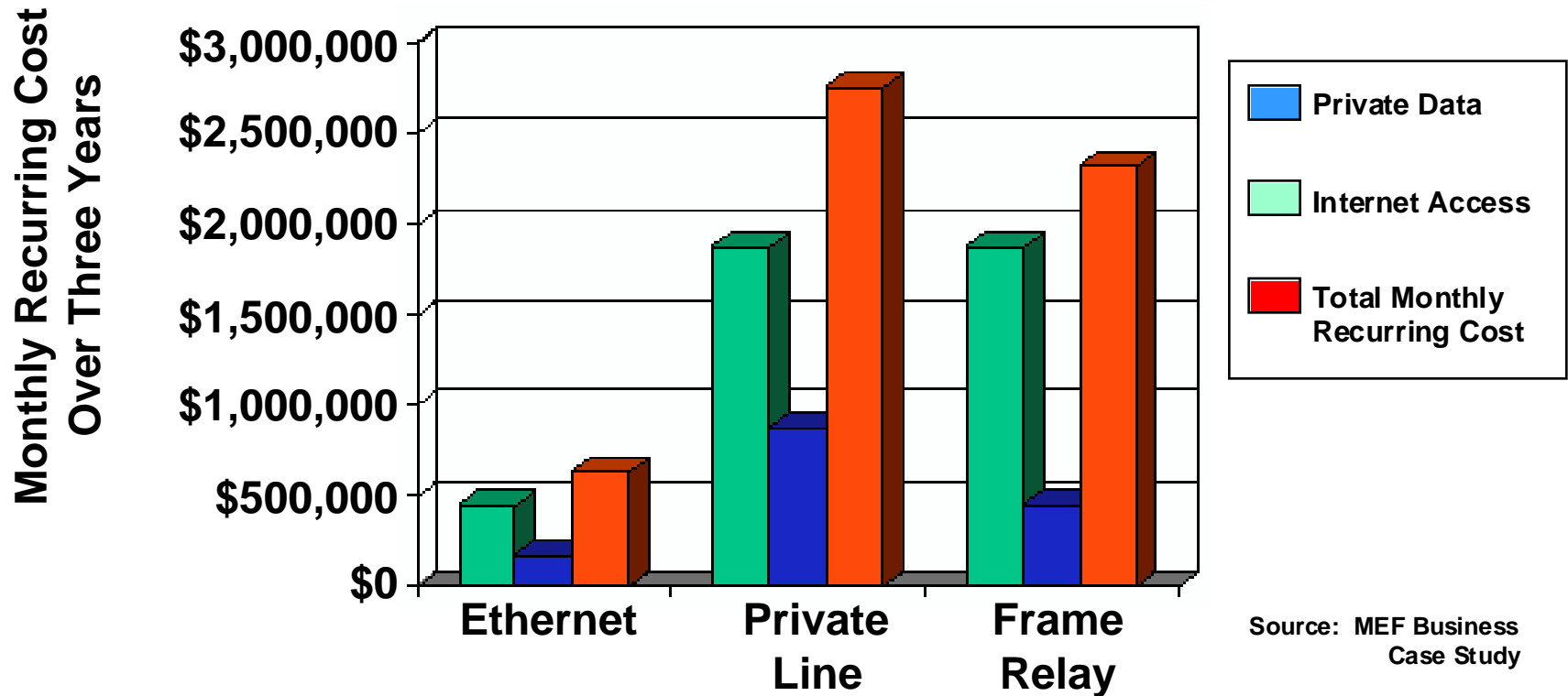
EPL - Ethernet Private Line
EPLAN - Ethernet Private LAN



EVPLAN - Ethernet Virtual Private LAN

- The different Ethernet services warrant different pricing models for alignment with similar service offerings
- The price of Ethernet services must be balanced to enable enterprise adoption while preserving profit margins for the carrier
- Bundling of Ethernet services with high-layer services brings the potential of higher revenue streams for the carrier

User Cost Advantages of Carrier Ethernet



- Carrier Ethernet can save more than 50% over a three year period.
- Significant user cost benefits.

Market Challenges and Drivers

Enterprise Challenges

1) Bandwidth

- LAN Centric changing to MAN & WAN Centric

2) Productivity Gains

- New Services / Applications

3) Competitive Adv

- Networks must enable differentiating capabilities

4) Cost containment

- Labor, software and hardware charges dominate

Service Provider Challenges

• Traffic increases

- Traffic growth rates greater than 50% CAGR

• Revenue flat or decreasing

- Need new revenue streams required

• Capex Focus

- 'Success-based' network deployment

• Opex containment

• Next Gen Broadband Access

Optical Ethernet Can

• Enable New Services Revenue

• Leverage Deployed Infrastructure

• Enhance Operational Efficiency

• Simplify Service Activation and Delivery

Optical Ethernet Addresses the Challenges

The Enterprise Perspective



1) Bandwidth - Enterprise Challenges



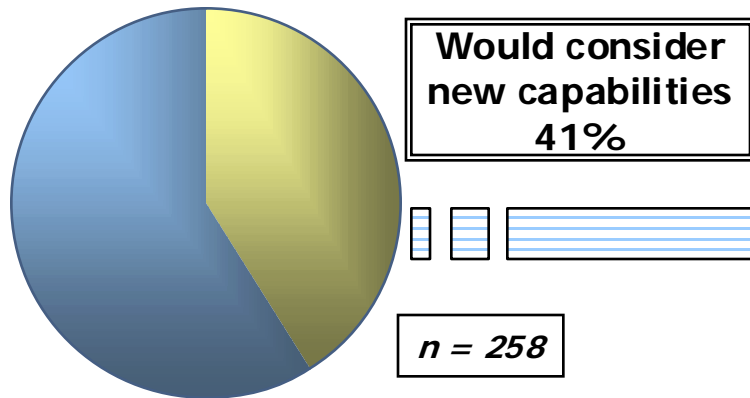
- **Access Bandwidth:** 80-20 rule changing to 20-80
- **Service Delivery:** Faster delivery and ubiquitous services
- **New Applications:** E-Business, Multimedia, Employee Mobility
- **Distributed Computing:** Cost of applications and support per user
- **Staffing:** Hiring, training and retaining of resources

Enterprises need to scale their LANs thru the Metro Bottleneck while reducing cost

2) Productivity Gains

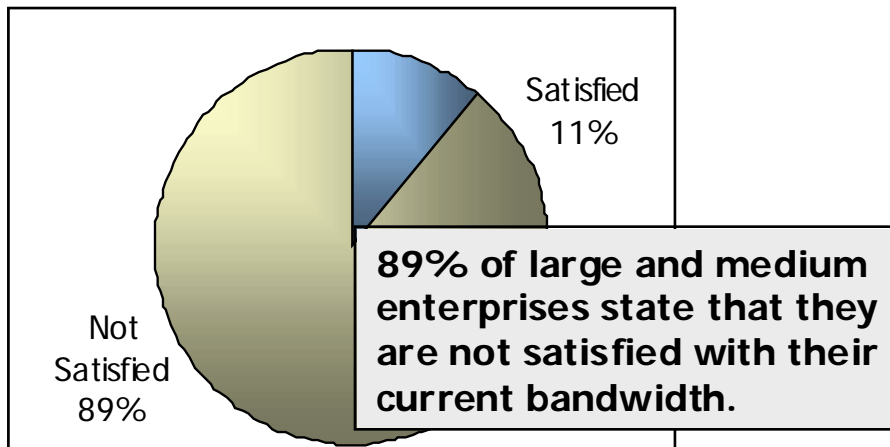
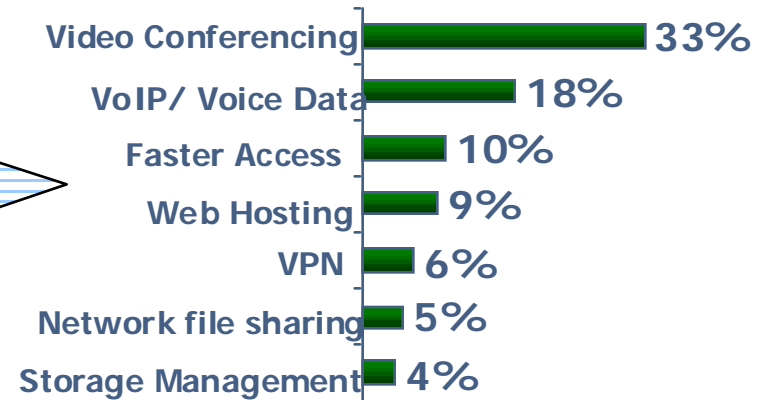
New Services thru Increased Bandwidth

Consider New Capabilities if Had Greater Bandwidth?



Quantitative Research Findings

New Capabilities Desired



Increased Bandwidth and Competitive Pricing Stimulate the Enterprise to Increase Spending on Value Add Services

Source: RHK Inc. March 2002

17

3) Competitive Advantage **for the Enterprise**

Sixty-eight percent of Global 2,500 companies expect their networks to provide competitive advantage

Network should provide effective information sharing and collaboration

- **Internal Communication: File sharing, Storage, Accessibility**
- **External communication with customers and suppliers**

Enable new Services

- **Support new services such as e-business tools, video conf., VoIP**
- **Quick and cost effective implementation: i.e. Single Application instance**



Networks should provide the Enterprise with a Competitive Advantage

4) Cost Reduction thru Optical Ethernet

Productivity

- Increased Collaboration and Information sharing
- Reduce the risk of downtime by eliminating network complexity

Operational Costs

- Simplified Provisioning and Auto-discovery reduce operational management requirements

Staffing

- Layer 2 Ethernet management reduces the need for specialized staff

Centralization

- Network Centralization reduces equipment costs

New Applications

- New applications can increase productivity and increase business efficiency

Capital Costs

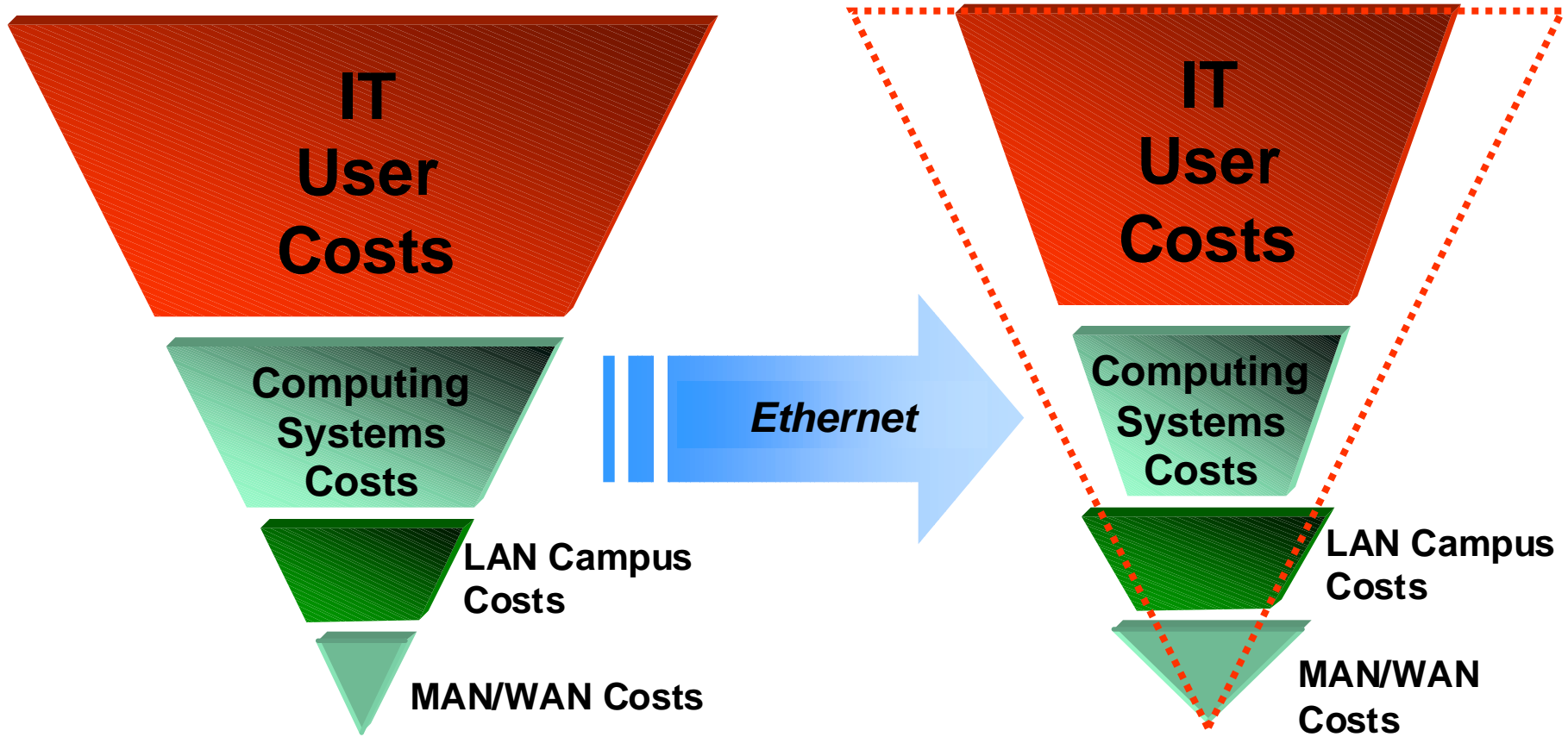
- Ethernet equipment costs much less than routers or other interworking devices with Telco interfaces

Cost per Mb

- Granular Bandwidth options and reduced cost/Mb makes bandwidth more cost effective

Optical Ethernet is the Simple and Scalable solution to drive down Enterprise Cost

CxO IT Opportunity



Enterprise Value for Optical Ethernet

Enterprise Objectives

- Better communication
- Faster information access
- Ensure business continuity
- Decrease IT Capex/Opex
- Increase employee productivity
- Improve resource utilization
- Evolve to engaged customer relationship

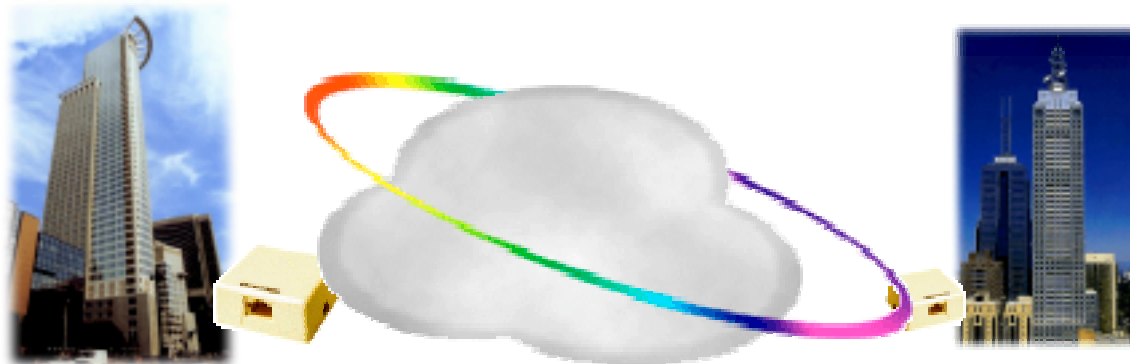
Optical Ethernet

- Integrates multiple underlying technologies to build massively scalable and highly reliable networks
- Provides a simpler, more efficient network that supports all types of traffic (voice, data, and video)
- Delivers cost-effective bandwidth and improved network performance
- Extends the Enterprise network globally, to other sites, partners, vendors

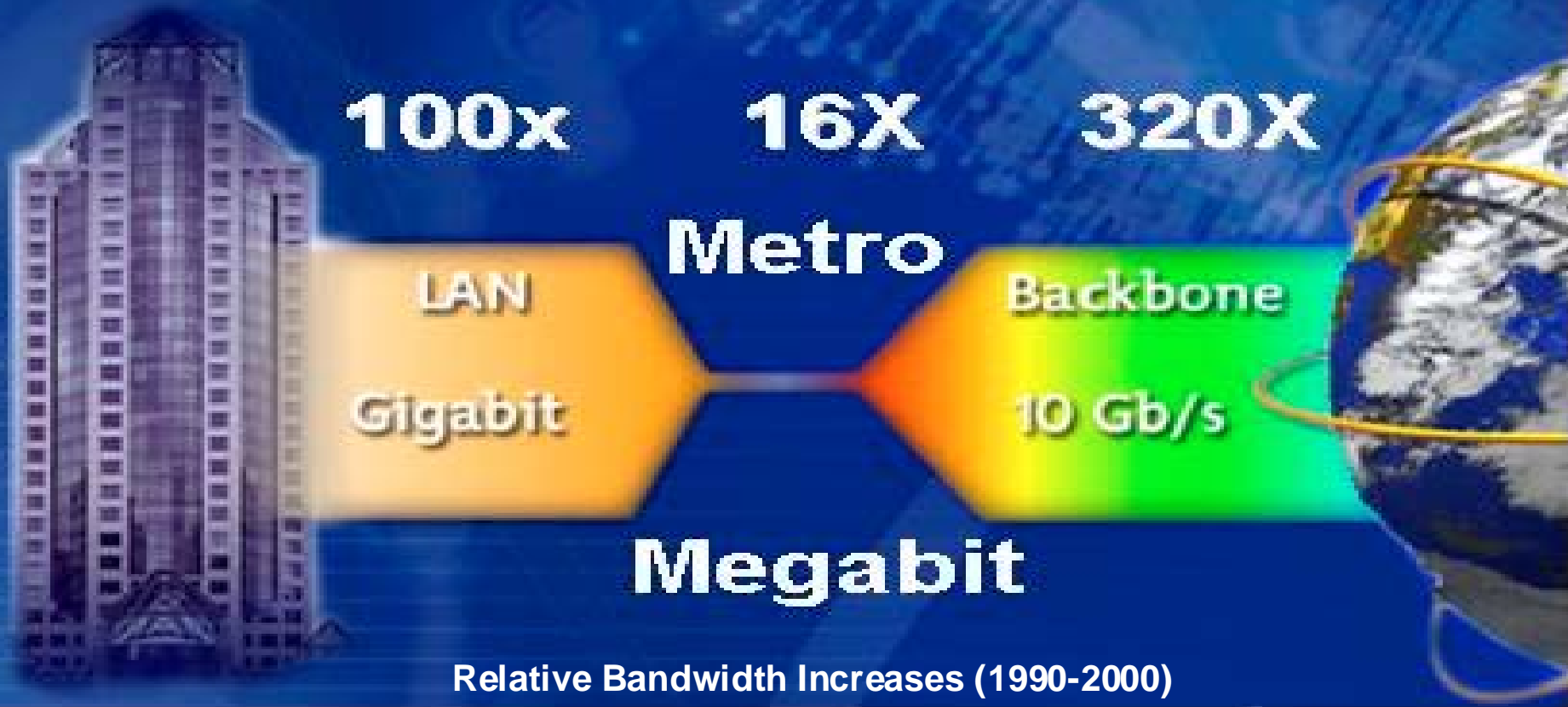


Optical Ethernet Delivers on the Enterprise Objectives

Service Providers & OE



The Metro Bandwidth Bottleneck

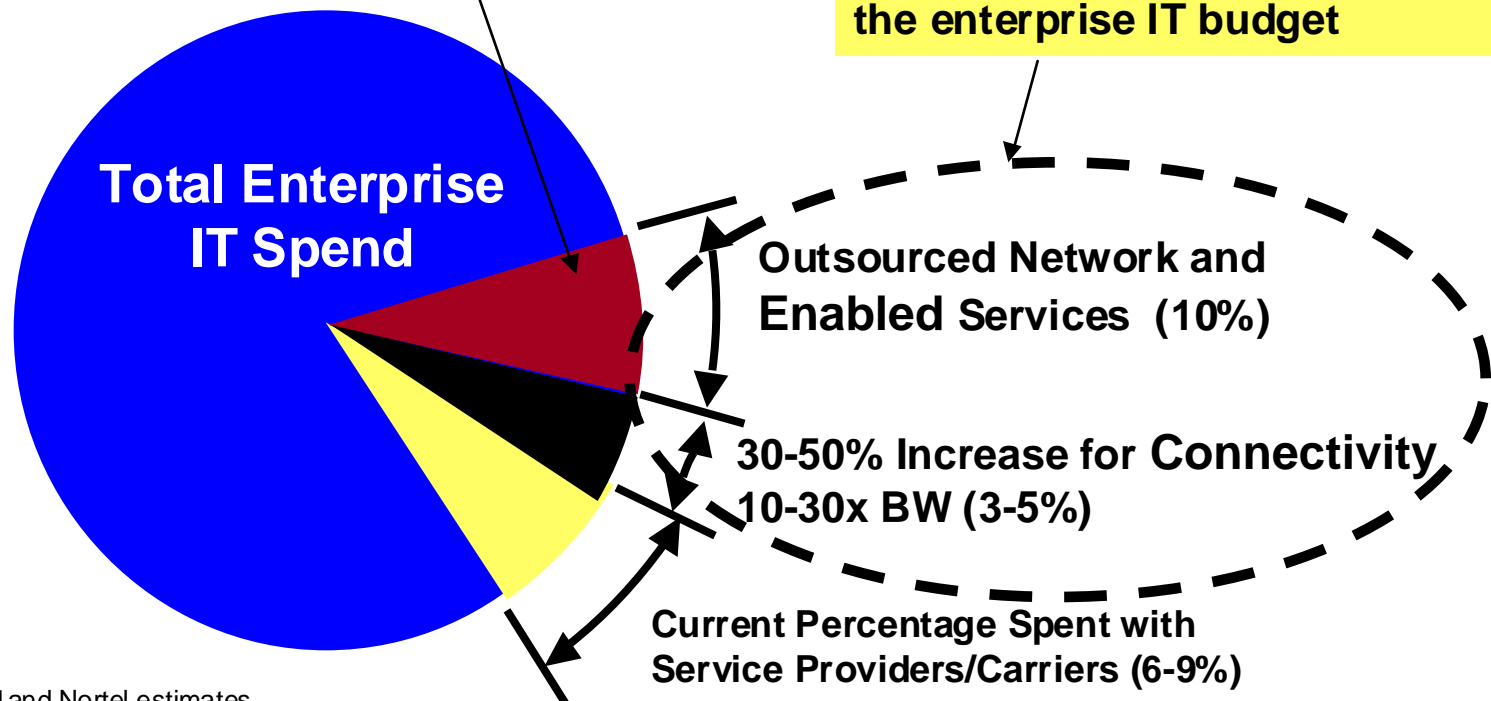


Optical Ethernet Bridges the Gap in the Metro Network

OE provides a win / win for Enterprises and Service Providers

Enterprise focus on cost reduction is leading to outsourcing of IT functions & IT centralization

Outsourced services provide an opportunity for service providers to capture an increased share of the enterprise IT budget

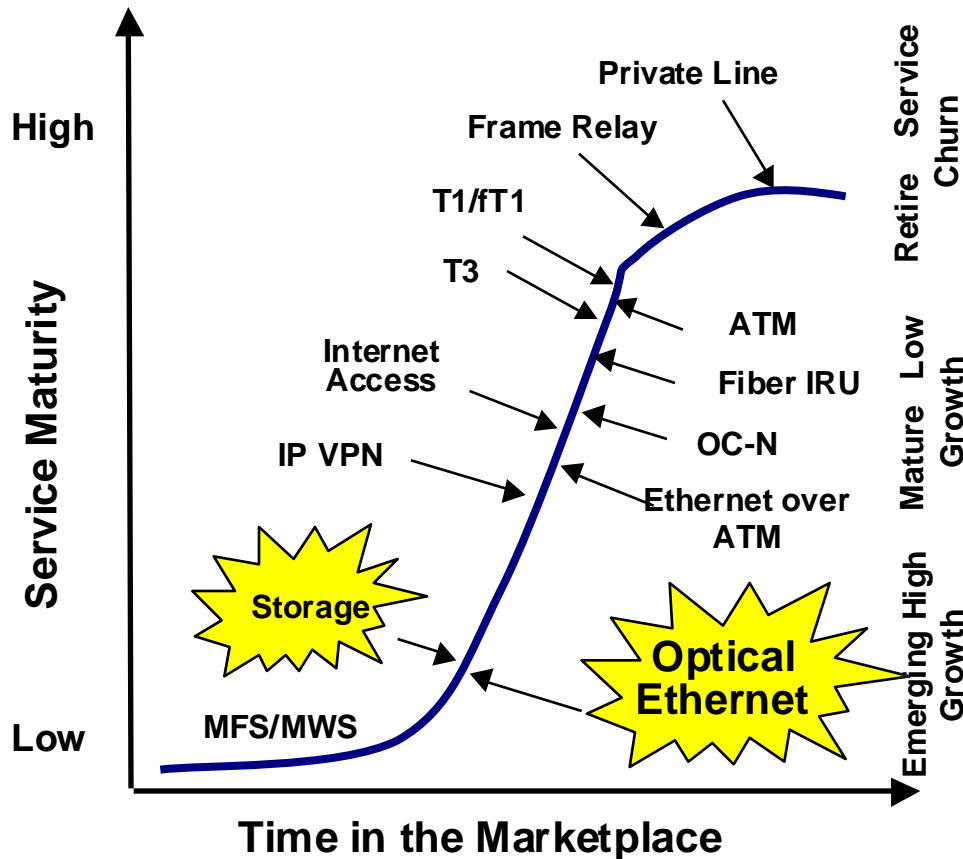


Source: IDC 2001 and Nortel estimates

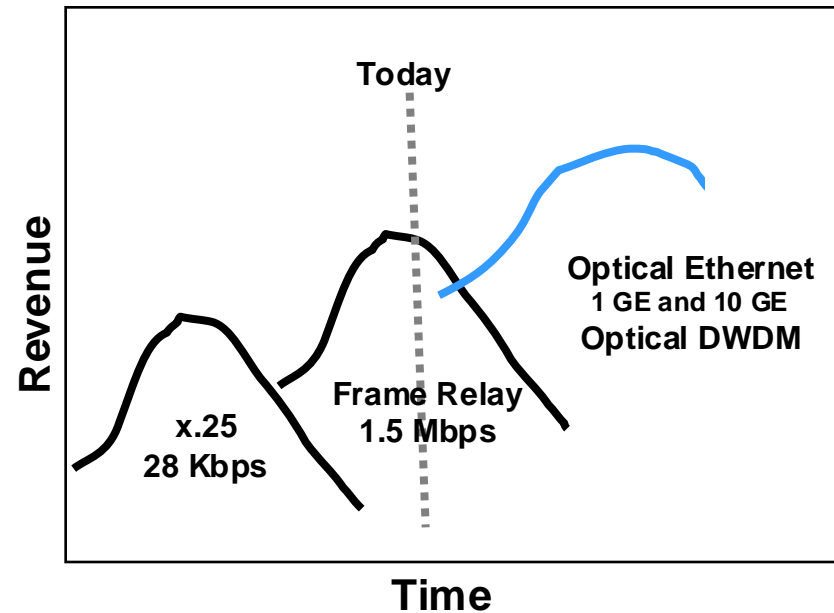
Enterprises' are moving their applications beyond the LAN and across the Metro backbones

Service Maturity & Evolution

Service Maturity



Service Evolution

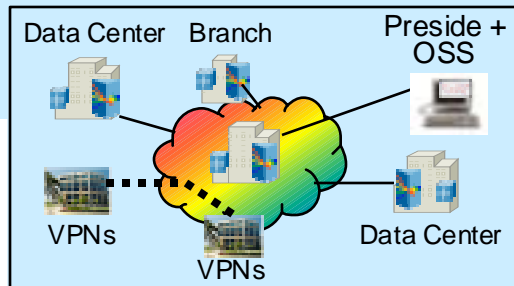


Fiber Availability, Bandwidth Demand, Service Pricing & New Technology are all Driving OE Demand

Industry Evolution Model

Phase 3: Hosted Optical Broadband Services

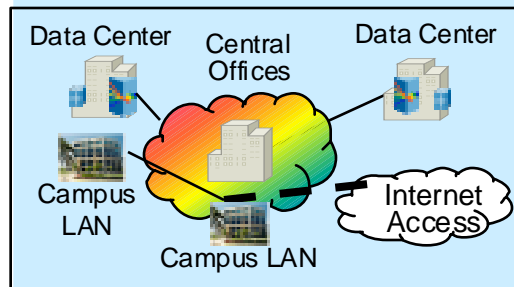
Automate



- Service convergence
- Scalable architecture
- Mass adoption

Phase 2: Managed Optical Broadband Services

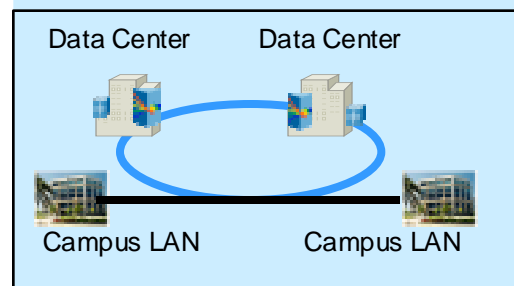
Migrate



- Carrier service translation
- Managed outsourcing
- Service assurance

Phase 1: Private Optical Networks

Introduce



- Individual customer builds
- Emerging applications
- Consultant relationship

Optical Ethernet is “Hot”

- ✓ **98%** of all LAN traffic starts & ends on Ethernet ports
- ✓ The **Metro bottleneck** is the key network challenge
- ✓ Ethernet has matured to become **WAN hardened**
- ✓ **10GE** has been ratified by IEEE
- ✓ OE market has a **100%** annual revenue **growth rate**
- ✓ OE **lowers cost** while **increasing revenues**

"The metro Ethernet equipment market is an enormous opportunity to vendors. Revenue and growth will be substantial and should attract the attention of any large telecommunications networking supplier looking for market growth opportunities over the next five years"

IDC Market Report 2002

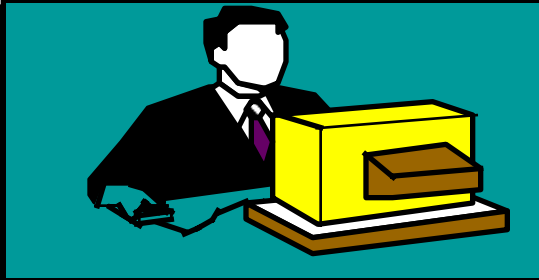
"Carriers are sold on the basic advantages of optical Ethernet. Every carrier we've spoken to is actively developing an Ethernet service. The economies of scale are just too compelling not to pursue this route."

Yankee Group - 2002

Service Providers that are not offering OE Services are finding the Enterprises are building their own OE Networks

Market Forecast & Opportunities

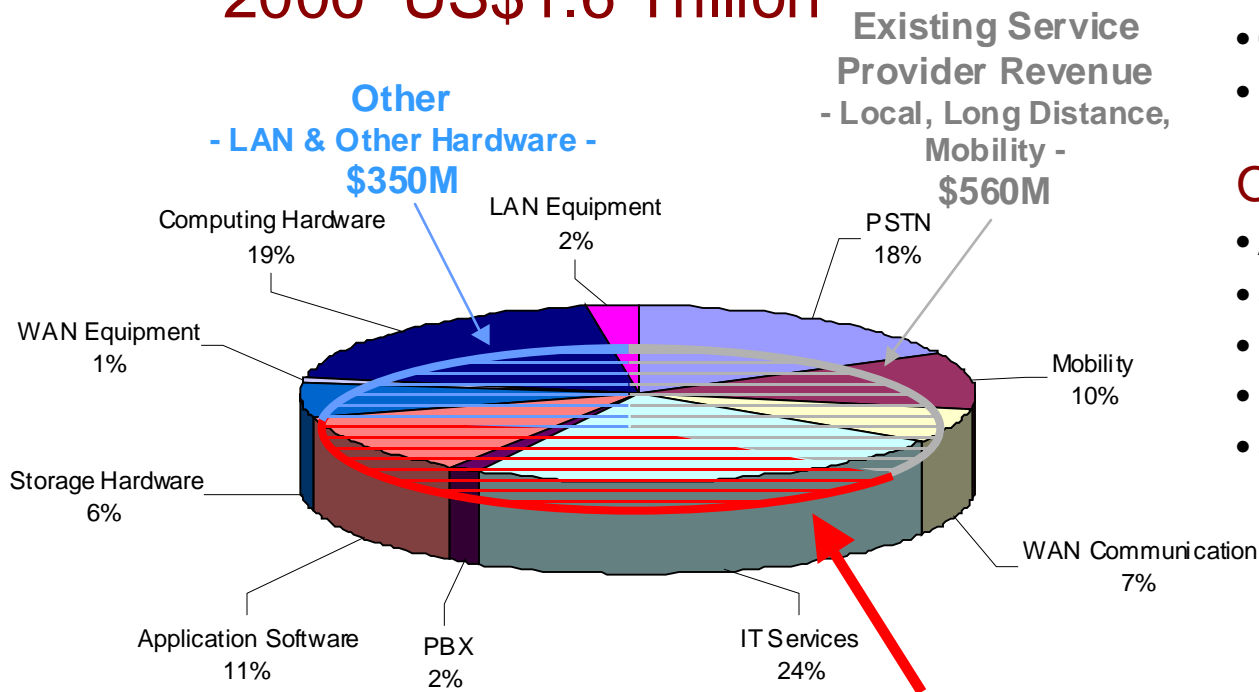
Show me the Numbers



5x the bandwidth
twice @ the price

Market Revenue Opportunity

Global Enterprise Spending,
2000 US\$1.6 Trillion



Enterprise Challenges

- Customer loyalty & retention
- Increasing flexibility & speed
- Lowering costs
- Competing for skilled resources
- Harnessing the Web

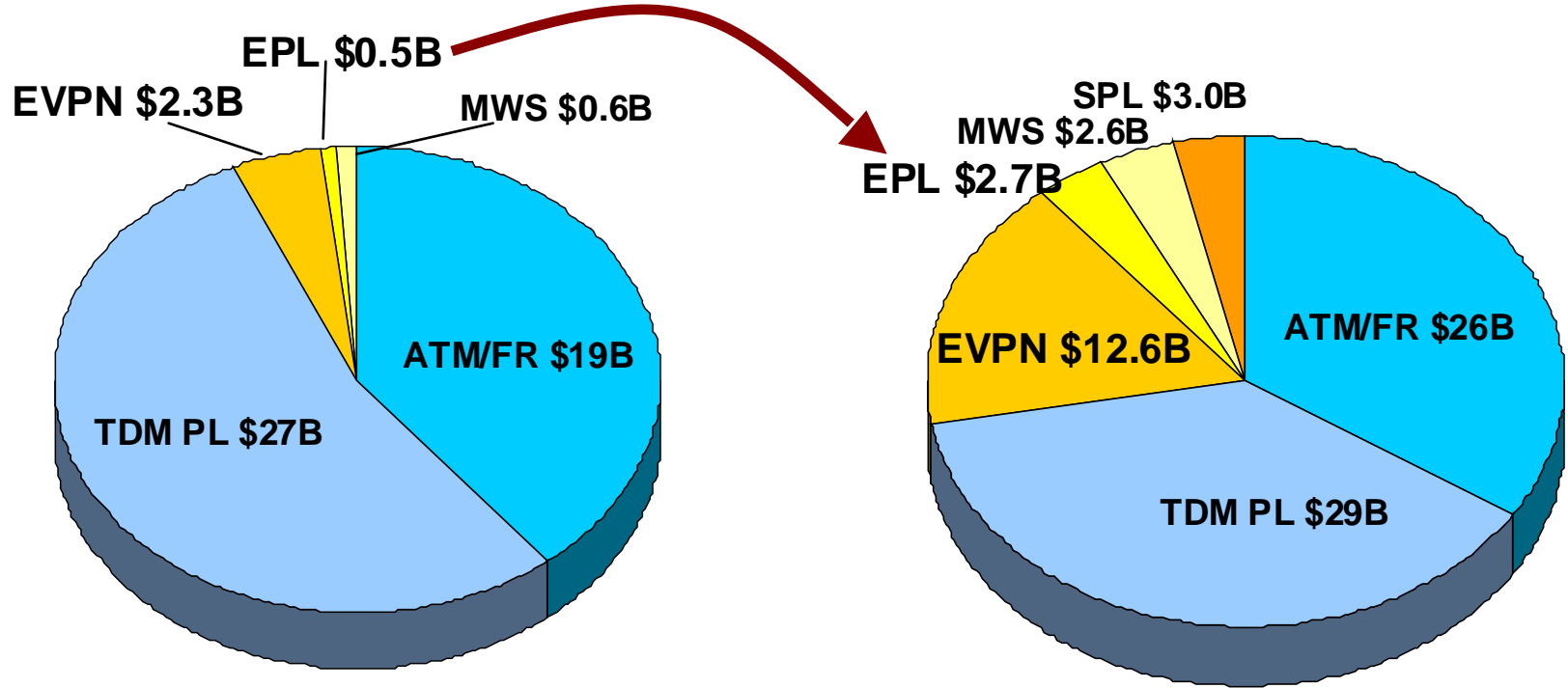
Outsourcing Value Prop

- Alignment of costs with core business
- Shift of fixed to variable costs
- Reduction of IT resources
- Introduction of new capabilities
- Services “on demand”

High Growth Areas

- Optical Ethernet Connectivity
- Managed IP Telephony
- IP VPN
- Security
- Storage
- Applications Outsourcing

Worldwide Business Connectivity Services Market Forecast



2003 E: \$49 Billion

2007 E: \$77 Billion

SOURCES Nortel Internal Research based on Vertical Systems Group ENS 2002 and 2003, IDC May 2003, Pyramid Research 2Q03, RHK March, May 2002; April 2003; Yankee Group Feb 2003, Dunn and Bradstreet 2Q03

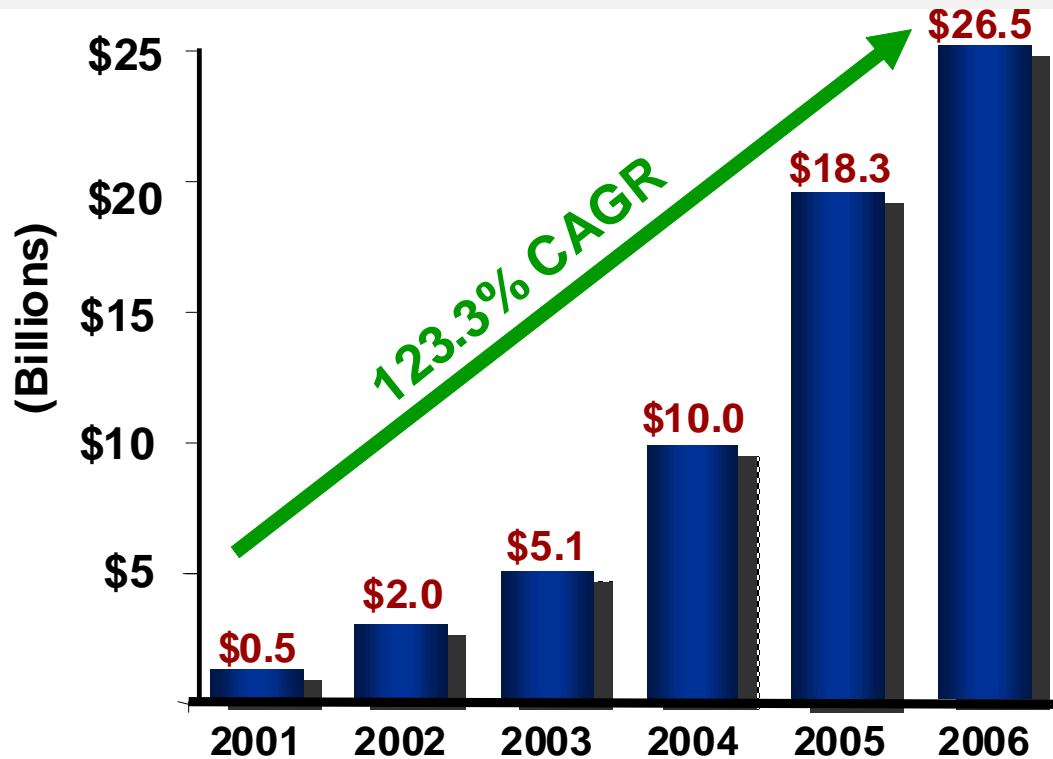


Optical Broadband Services Opportunity grows from \$3.1 Billion in 2003 to \$21 Billion in 2007 with CAGR 61%

Market Forecast for OE

“Carriers are sold on the basic advantages of Optical Ethernet. Every carrier we've spoken to is actively developing an Ethernet service. The economies of scale are just too compelling not to pursue this route.”

Yankee Group

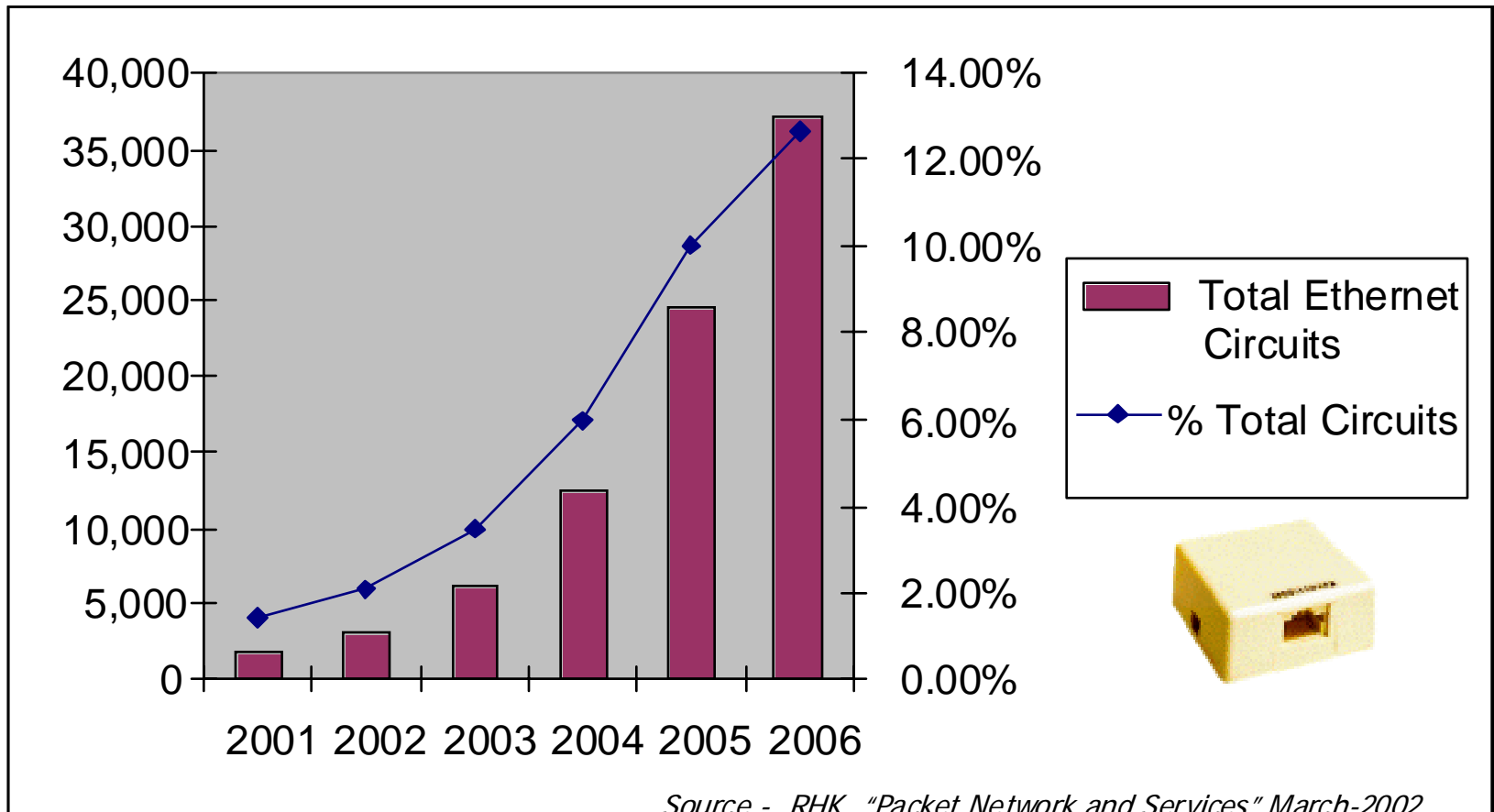


Source: Worldwide Metro Ethernet Forecast and Analysis, IDC, Dec. 2002

The worldwide market for Optical Ethernet Services will grow to \$26 Billion by 2006

Optical Ethernet Growth

Metro Circuits via Ethernet

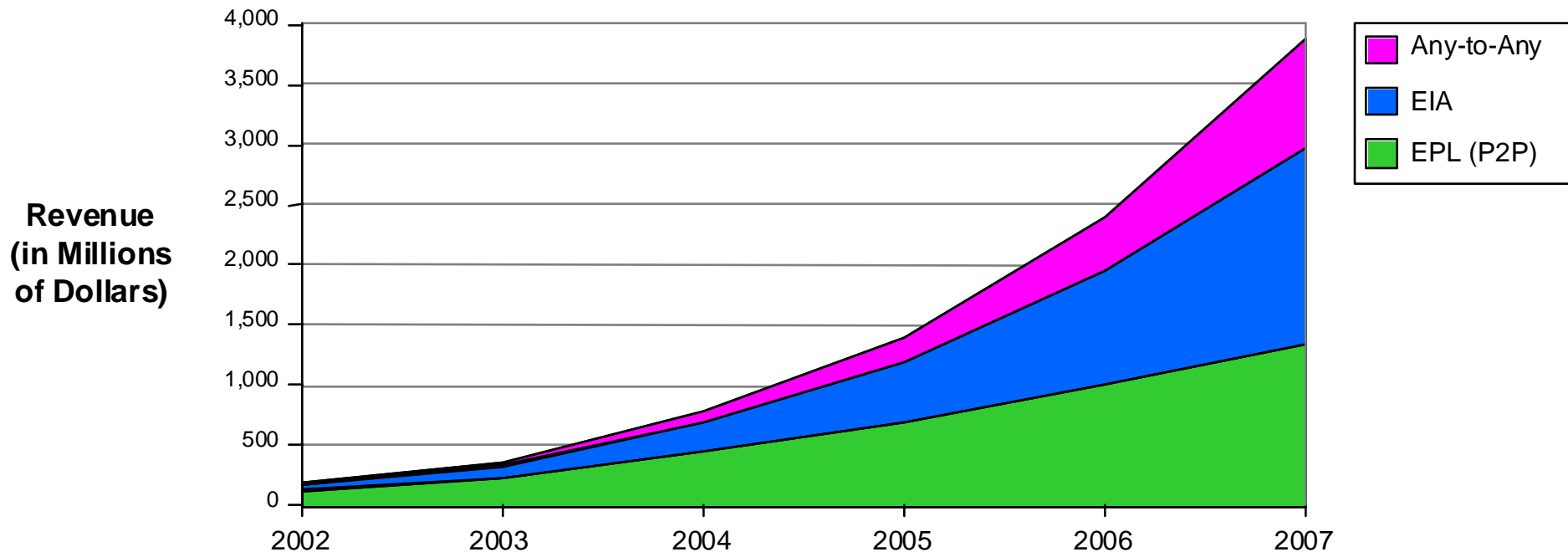


Ethernet has "Moved out of the Building"

Metro Ethernet Services Market

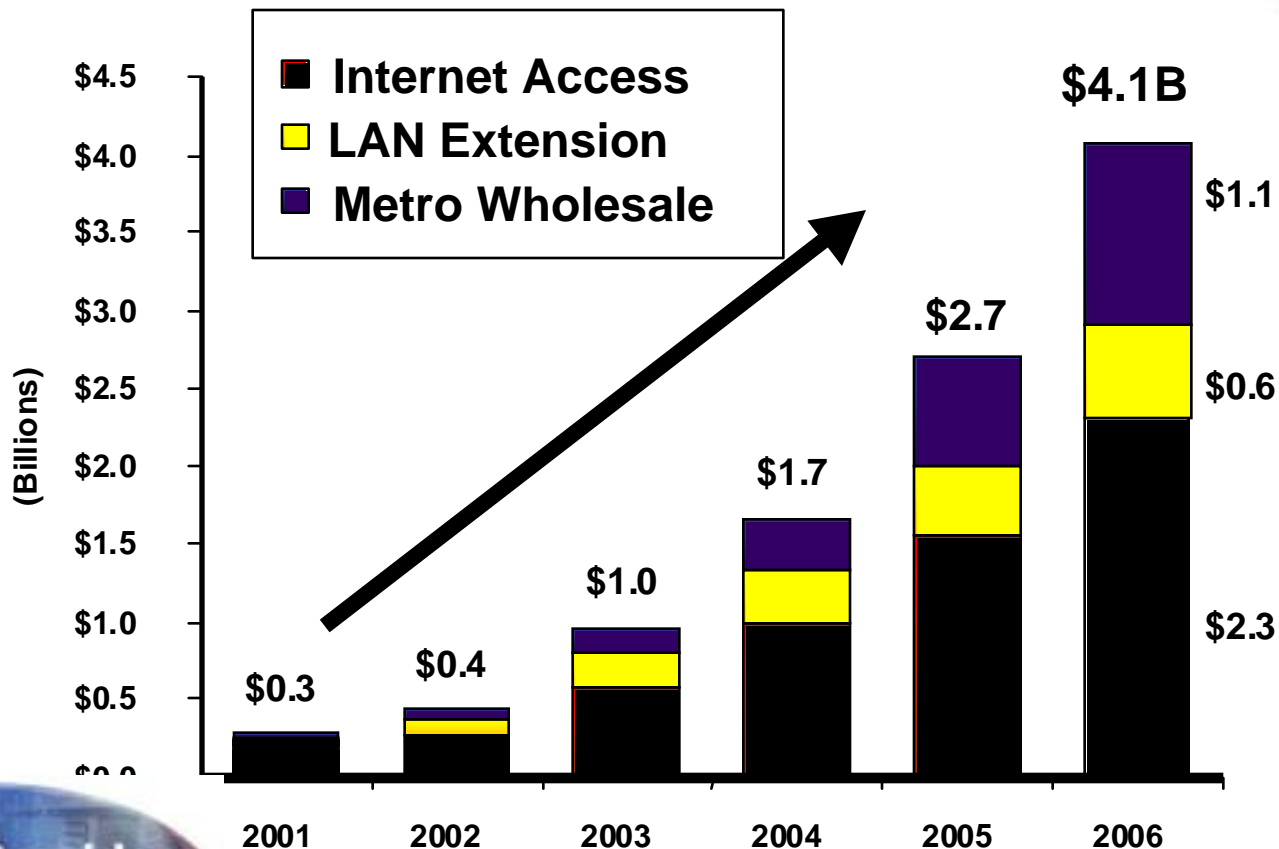
- Ethernet Line (E-Line) = Pt-Pt CAGR: 58.6%
- Ethernet LAN (E-LAN) = Any-to-Any CAGR: 134.2%

U.S. Ethernet Services Forecast



OE Enabled Services

Forecast for Enterprise Services



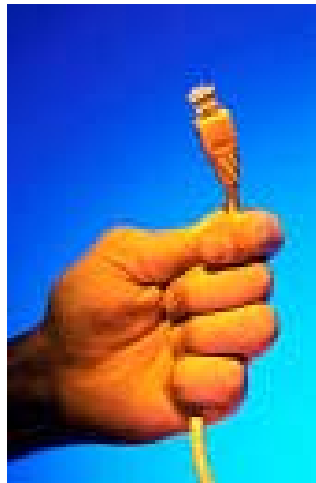
Source - RHK 2001

North America Market Forecast - Metro Ethernet

Key Applications Growth Areas



Making Ethernet Carrier Class

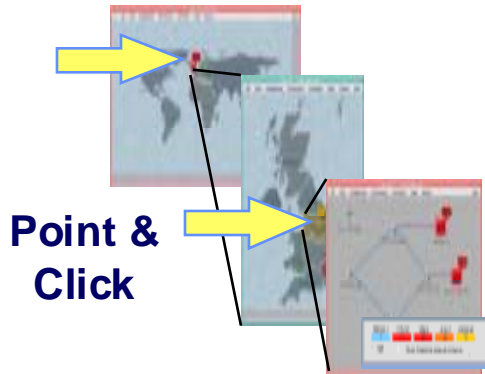


Making Ethernet Carrier Class

- **NEBS Is a Starting Point**
- **Scaleability Is Important**
 - Add hundreds of customers, new subscribers
 - Ability to modify change and reconfigure subscriber SLAs
 - Scaling the core Ethernet network for capacity growth
 - Carrier-class protection in the core as well as access
- **Simple Service Provisioning Is Critical**
 - Fast moves, adds, and changes to physical and logical configurations
 - Point-and-click end-to-end service provisioning in seconds
 - SLA monitoring and reporting per subscriber per service

Operational Challenges

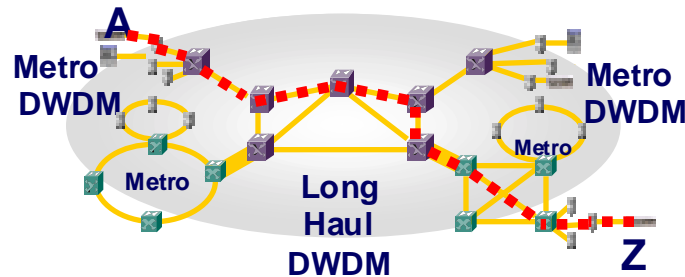
How do I efficiently enable data/optical surveillance for my OE network?



Point & Click

- Integrated data/optical tools to support combined or separate NOCs
- Offer standard OSS interfaces

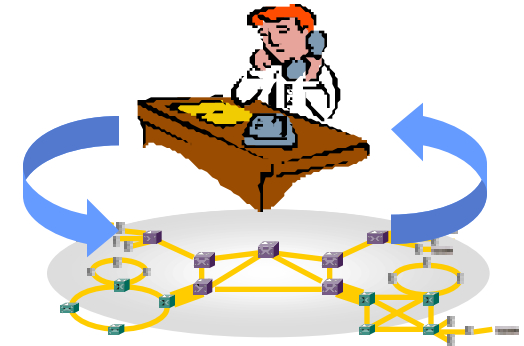
How do I rapidly & simply provision data & optical connections?



Reduce opex & enable rapid service activation with powerful connection management tools

- Optical Provisioning
- Optical Ethernet Provisioning

How do I ensure quality of services for my customers?



Ensure your customers' services meet SLA

- Performance Management – Optical & Ethernet
- Standard interfaces for OSS integration

The right tools for simple & efficient data/optical management

SLAs of Supreme Importance

Network reliability and service level agreements

Ability to interconnect all remote LANs

Price of bandwidth

Ability to quickly increase bandwidth

Data storage and web hosting

Integration of voice and data services

Outsourcing network management

81%

57%

50%

29%

21%

18%

8%

Source: RHK Inc. 2002

Value-Add
Services

Service & SLA selection for an enterprise will depend on:

Application Drivers

- *Storage Area Networking*
- *Real-time Data Warehousing*
- *Real-time Data Recovery*
- *Voice over IP*
- *Streaming Video*
- *Video Conferencing*

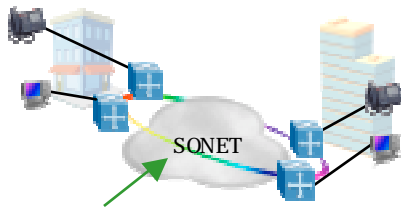
Business Drivers

- *Security*
- *Reliability*
- *Affordability*
- *Flexible Pricing*
- *Scalable Bandwidth*
- *Multi-site Connectivity*
- *Service Assurance*

Next Generation SONET Enables Ethernet

Legacy SONET

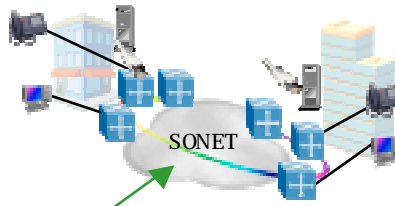
- Multi-box TDM based
- Single Service
- Costly Reliability



Asia: \$2.94B in 2000*
WW: \$18.96B in 2000*

Metro Ethernet

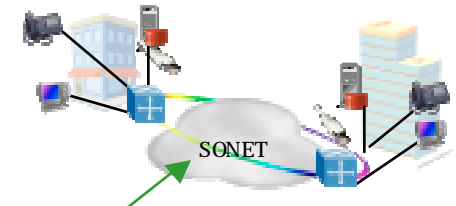
- Multi-box – TDM & Ethernet
- Best effort Ethernet MANs
- New Builds



Asia: \$3.42 B in 2001*
WW: \$14.28 B in 2001*

Metro Ethernet over Next Gen SONET

- Multi-Service Broadband
- Carrier Grade Ethernet
- Lowest TCO



Asia: \$8.45 B from 2000-2002!*
WW: \$38.93B from 2000-2002!*

Innovation driving lower costs

*\$US revenue numbers are from RHK and include all SONET/SDH equipment deployed in that year

Leveraging a \$39B installed base of SONET with Next-Generation SONET is an excellent enabler of Metro Ethernet.

Ethernet – A Universal Service Interface

- Ethernet has undeniable price / performance benefits.
- **The Danger:** Getting trapped in a commodity bandwidth price war.
- Change the game!
- Deliver a portfolio of value added Ethernet Services:
 - Multipoint Ethernet LAN Services (E-LAN)
 - Point to Point Ethernet Line Services (E-Line)
 - Services Interworking – Ethernet to ATM/Frame Relay
 - Internet Access



OE Provides the Connection between *the Service Provider and the Enterprise*

**Service
Provider**



Connectivity Services

Profitable Network Services

Ethernet Private Line
Ethernet Virtual Line
Ethernet Private LAN
Ethernet Virtual LAN

Enabled Services

End user Enterprise Services

Internet Access
LAN Extension
Metro Wholesale
Voice & Video

Enterprise

How to Join or Get More Information?



- Companies interested in membership should visit the web site where they can complete an application. The Metro Ethernet Forum application is located on our web site:

<http://www.metroethernetforum.org/membership.htm>

- The MEF web site contains a great deal of information about the Forum. Please contact Manager of the Forum for additional information.

Manager@MetroEthernetForum.org

949-250-7188

Newport Beach, CA, USA

Back up

MEF Key Objectives

- **Build consensus and unite** service providers, equipment vendors, end customers on optical Ethernet
- **Facilitate implementation** of optical Ethernet standards to allow delivery of *Ethernet services* and make *Ethernet-based metro transport networks carrier-class*
- **Enhance worldwide awareness** of the benefits of optical Ethernet services and Ethernet-based metro transport networks
- **Enable Ethernet applications and services**, building on the physical transport specified by e.g. 10GEA

MEF Technical Work Dash Board

MEF Technical Committee

Conformance & Performance

Test Area

Process Ad-Hoc

TC Rules and Procedures

Management Area

OAM&P

Ethernet Services OAM d4

EMS Mgmt

EMS Requirements d1

EMS-NMS If

EMS-NMS Information Model d3

Architecture Area

MEN Architecture

MEN Architecture FW Part 1 d1
MEN Architecture FW Part 2
MEN Architecture FW part 3
MEN Architecture FW part 4
MEN Architecture FW part 5

UNI

UNI Requirements d2

UNI Framework d3

UNI PVC IA d1

EI-NNI

EI-NNI TS d1

Protocol & Transport Area

QOS

QOS Framework d2

Protection

Protection Requirements d3

Protection Framework d3

MPLS Protection IA d1

EoS

EoS IA d1

NI-NNI

MPLS NI-NNI D1

EMF

Services Area

Ethernet Services

Ethernet Services Model d4

Ethernet Services Definitions d2

Traffic

Mgmt

Traffic Performance Parameters d5

CES

CES Requirements d2

Legend

Gray Color = Not Approved Project

Orange Color = Approved Project

Blue Color = Draft Status

Green Color = Approved Standard

Red Color = Sent to Ballot